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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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1. Your reference — RH/DAS/SEB/P/76256.GB/B

2. Patent application number *(The Patent Office will fill in this part)* — 0408660.9 — 19 APR 2004

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

MELEXIS NV
Microelectronic Integrated Systems
Rozendaalstraat 12
B-8900 Ieper
Belgium

Patents ADP number *(if you know it)* — 8351702001

If the applicant is a corporate body, give the country/state of its incorporation — Belgium Corporation

4. Title of the invention — OPTICAL DATA TRANSCEIVERS AND METHODS OF MANUFACTURING THEREOF

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

WILSON GUNN SKERRETT
CHARLES HOUSE
148/9 GREAT CHARLES STREET
BIRMINGHAM B3 3HT
UNITED KINGDOM

Patents ADP number *(if you know it)* — 7710734001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

a)

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Continuation sheets of this form	
Description	11
Claim(s)	
Abstract	
Drawing(s)	2

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for preliminary examination and search (Patents Form 9/77)	
Request for substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature: Wilson Gunn Skerrett

Date: 19 April 2004

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr D Slattery
0121 236 1038

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Notes

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OPTICAL DATA TRANSCEIVERS AND METHODS OF MANUFACTURING THEREOF

The present invention relates to optical data transmission systems and in particular to optical data transceivers and methods of manufacture thereof.

Optical data transmission systems use light to carry digital data along fibre optic cables. The light is generated by a first transceiver, coupled to the fibre, and travels along the fibre to its far end whereupon it is incident upon a second transceiver. The first transceiver acts to convert electrical signals into optical signals and the second transceiver acts to convert the optical signals back into electrical signals. This process may of course be reversed, with signals being sent from the second transceiver to the first transceiver, if desired.

Each transceiver has an optically active element or elements typically the optically active elements are a light emitting means and a light sensing means. It is however possible, if data transmission is required in a single direction only, that transceivers may be adapted only to emit light or to sense light i.e. to have a single optically active element being either a light emitting means or a light sensing means as appropriate. In this application, the term transceiver is used to encompass all three possibilities.

Conventionally, optical transceivers are packaged in a protective housing into which an optical fibre may be inserted and releaseably retained. To allow the fibre to be inserted and retained, an opening is provided in the housing, said opening being of a cross-section corresponding to the cross-section of the optical fibre and extending

from the surface of the housing to the light emitting and or light sensing means of the transceiver. As the cross-section of the optic fibre is typically greater than that of the light sensing or emitting means, a proportion of the light emitted by the light emitting means does not travel along the optic fibre and similarly a proportion of the light that does travel along the fibre is not incident upon the light sensing means. These losses reduce the effective intensity of the transmitted data signals and hence reduce the efficiency, the sensitivity, data rate, Bit Error Rate, and maximum communication range of the signal from their optimum values.

One way to combat these losses is to increase the intensity of the emitted signal. There are however legal limits for the maximum output signal intensity imposed to protect the vision of any person working with or using such devices. As a result the losses cannot be fully compensated for.

It is therefore an object of the present invention to provide a method of packaging an optical data transceiver that overcomes or alleviates some or all of the above problems.

According to a first aspect of the present invention there is provided a method of packaging an optical data transceiver comprising the following steps: providing an integrated circuit, the integrated circuit having at least one optically active element; mounting a reflector means on said integrated circuit, said reflector means being operable to direct light from an optical fibre inserted into the reflector means onto said [illegible]

with and seals with the reflector; introducing a plastic mould compound into the cavity so as to encapsulate the assembly except for the portion in contact with the projection; and removing the assembly from the cavity, whereby there is an opening defined in the plastic mould encapsulating the assembly through which optical access may be gained to the assembly.

In this manner, a packaged optical transceiver may be provided wherein the losses of transmitted optical signals are reduced and hence the efficiency, the sensitivity, data rate, Bit Error Rate, and maximum communication range of the data signals are improved.

Preferably, a quantity of gel may be applied to the assembly so as to cover at least the optically active elements before encapsulation. Most preferably, said quantity of gel may be shaped so as to form a lens to assist said reflector element with directing light from an optical fibre inserted into the reflector means onto said optically active elements and to deflecting light from said optically active elements into said optical fibre

In one preferred embodiment, the optical transceiver is an optical transceiver of the type comprising two optically active elements, a light emitting means and a light sensing means. In an alternative preferred embodiment, the optical transceiver is an optical transceiver of the type comprising a single optically active element being a light emitting means. In a further alternative preferred embodiment, the optical transceiver is an optical transceiver of the type comprising a single optically active element being a light sensing means. In a particularly preferred embodiment, the optical transceiver is an optical transceiver of the type comprising three optically

active elements: a light emitting means operable to emit light in response to received electrical signals; a mounting means suitable for retaining an end of an optical fibre in position adjacent to said light emitting means; a first light sensing means operable to detect light emitted by the light emitting means and reflected from the end of said optical fibre, said first light sensing means being operable to output a signal indicative of the intensity of the reflected light; a second light sensing means operable to detect light incident upon said transceiver unit from an external source via said optical fibre and output electrical signals in response thereto; and control means operable to vary the intensity of the light emitted by the light emitting means in response to the output of the first light sensing means.

In one preferred embodiment, the optical transceiver is an optical transceiver of the type comprising two optically active elements, a light emitting means and a light sensing means. In an alternative preferred embodiment, the optical transceiver is an optical transceiver of the type comprising a single optically active element being a light emitting means. In a further alternative preferred embodiment, the optical transceiver is an optical transceiver of the type comprising a single optically active element being a light sensing means.

In a particularly-preferred embodiment, the optical transceiver is an optical transceiver of the type comprising three optically active elements: a light emitting means operable to emit light in response to received electrical signals; a mounting

sensing means being operable to output a signal indicative of the intensity of the reflected light; a second light sensing means operable to detect light incident upon said transceiver unit from an external source via said optical fibre and output electrical signals in response thereto; and control means operable to vary the intensity of the light emitted by the light emitting means in response to the output of the first light sensing means. In such embodiments said optical transceiver unit is adapted to transmit light of a first wavelength and to receive light of a second wavelength. Furthermore said light emitting means is adapted to emit light of a first wavelength and said first light sensing means is adapted such that it detects substantially only light of said first wavelength by means of a filter, an interference coating or otherwise. Said second light sensing device may be an independent light sensing device or may be a portion of the first light sensing means operable to provide a distinguishable signal and which is adapted such that it detects substantially only light of said second wavelength by means of a filter, an interference coating or otherwise.

Preferably, the optic fibre is a plastic optic fibre (POF) or a polymer cladded silica fibre (PCS).

Preferably, said optical transceiver comprises an integrated circuit incorporating said optically active elements; and a lead frame, said integrated circuit being mounted on and electrically connected to said lead frame. Preferably, bond pads are provided on said integrated circuit by means of which connections may be made from said integrated circuit to said lead frame and hence to external circuitry.

The optically active elements may be implemented on a single integrated circuit or may each be implemented on independent integrated circuits, said

independent integrated circuits being electrically connected and physically fixed in a desired relative position. Alternatively any combination of the optically active elements may be implemented on a single integrated circuit as is convenient, required or desired.

Preferably said gel blob is adapted so as to form a lens to assist said reflector means in directing light from said optic fibre to said optically active elements and in directing light from said optically active elements to said optic fibre.

The present invention may be adapted for use in any optical data transmission system or any optical data link. By use of appropriate combinations of transmitter units according to the first aspect of the present invention and transceiver units according to the second aspect of the present invention, duplex, half duplex and simplex links may be provided as appropriate or as desired.

One particular use of optical data transmission systems is in vehicular or automotive control or entertainment systems such as those operating to the MOST standard. Another application for such data transmission systems is for use in transmitting data between a digital imaging device and an image processing means such as those used in various automotive applications including lane following and parking assist.

According to a second aspect of the present invention there is provided a [illegible]

coated assembly into a cavity of a moulding tool ensuring that at least a projection of the moulding tool is in contact with the gel-coated assembly; introducing a plastic mould compound into the cavity so as to encapsulate the gel-coated assembly except for the portion in contact with the projection; removing the assembly from the cavity, whereby there is an opening defined in the plastic mould encapsulating the assembly through which the assembly can be accessed; and mounting a reflector means in said opening, said reflector means being operable to direct light from an optical fibre inserted into the reflector means onto said optically active elements and to deflect light from said optically active elements into said optical fibre.

The method of packaging an optical data transceiver according to the second aspect of the present invention may incorporate any or all of the features described in relation to the first aspect of the invention as appropriate.

According to a third aspect of the present invention there is provided a packaged optical data transceiver manufactured in accordance with the first aspect or the second aspect of the present invention.

The optical transceiver unit according to the third aspect of the present invention may incorporate any or all of the features described in relation to the first or second aspects of the invention as appropriate.

In order that the invention is more clearly understood, it will now be described further herein, by way of example only and with reference to the following drawings in which:

Figure 1 is a plan view of an optical data transceiver; and

Figure 2 is a cross-sectional view of a packaged optical data transceiver according to the present invention.

Referring now to figure 1, an optical data transceiver 100 comprises an integrated circuit 101 upon which is implemented second light sensing means 104, light emitting means 105 and first light sensing means 106, a mounting and reflecting means 102 and bond pads 107, said bond pads being electrically connected to said integrated circuit 101.

The mounting and reflecting means 102 is operable to direct light emitted by the light emitting means 105 at wide angles into an optical fibre 207 and to direct light proceeding from the end of optical fibre 207 to the first and second light sensing means 106, 104. It is also operable to retain the optical fibre 207 in position relative to the light emitting means 105 and the first and second light sensing means 106, 104. The mounting and reflecting means 102 is mounted on to the integrated circuit 101 by adhesive 206. In order to direct light from the light emitting means 105 into the optical fibre 207, the mounting and reflecting means 102 has a curved inner surface which is adapted to reflect a large proportion of incident light. The surface may be adapted to reflect light by being polished, metallised or covered with a reflective coating. To improve reflective performance if the surface is polished, the whole mounting and reflecting means 102 may be formed from white material.

Referring now to figure 2, the integrated circuit 101 is mounted on a lead

lead frame 205 by means of which the optical transceiver 100 may be connected to external circuitry.

Once said integrated circuit 101 is mounted on said lead frame, said reflector means 102 is mounted on said integrated circuit 101, said reflector means being aligned so as to reflect light from said light emitting means into said optic fibre 207 and to reflect light from said optic fibre onto said light sensing means 106, 104.

In an alternative preferred embodiment, said reflector means is attached to said integrated circuit whilst said integrated circuit is in wafer form.

Once the reflector means 102 is in position, a blob of gel 110 is applied to the optically active elements. The blob of gel 110 may be amorphous or may be shaped so as to form a lens and accentuate the effect of the reflector means 102. The integrated circuit 101, lead frame 205 and reflector 102 are then placed into the cavity of a moulding tool. The cavity has a projection adapted to be in contact with said reflector means 102.

A moulding compound 111 is then introduced into the cavity so as to encapsulate the integrated circuit 101, lead frame 205 and reflector 102 except for the peripheral portions of lead frame 205 and an opening corresponding to the position of the projection above said reflector means. The moulding compound 111 provides protection for all the components of the optical transceiver 100 whilst leaving an opening through which an optical fibre 207 may be inserted to allow light to be directed to said light sensing means 104 and directed away from said light emitting means 105.

The gel blob 110 provides protection for the optically active elements during and after encapsulation. It is also possible that, the gel blob 110 may be added after encapsulation if the projection is adapted so as not to damage the optically active elements of the integrated circuit 101 during encapsulation or may even be omitted altogether, if desired. The gel may be any suitable transparent compound such as a transparent epoxy or a silica based gel. The gel blob 110 may be formed to any desired shape by use of any suitable method.

In a further alternative embodiment, it is possible that the reflector means is not mounted to said integrated circuit 101 until after encapsulation. In such embodiments, a blob of gel 110 is applied to protect the optically active elements during encapsulation, the projection of the mould tool remaining in contact with the gel blob 110 during encapsulation, thereby providing an opening over said gel blob 110. The reflector means 102 is then inserted into and mounted in said opening thus providing a packaged optical transceiver 100 as described above. In such embodiments, it is also possible that, if desired, the gel blob 110 may be omitted, provided that the projection is adapted so as not to damage the optically active elements of the integrated circuit 101 during encapsulation.

The above described methods may also be adapted to include the further step of applying Teflon tape to the unpackaged transceiver in the mould cavity. to cover at least the optically active elements. This provides additional protection for the

both in addition to the embodiment described herein comprising light emitting means 105 and first and second light sensing means 106, 104 for monitoring and controlling the performance of the light emitting means in addition to receiving optical signals.

Often optical data transmission systems use optical fibres 207 terminated by a ferrule. In order to comply with such systems, the packaged transceiver may be adapted to have a ferrule receiving means fitted thereto.

It is of course to be understood that the invention is not to be limited to the details of the above embodiment which is described by way of example only.

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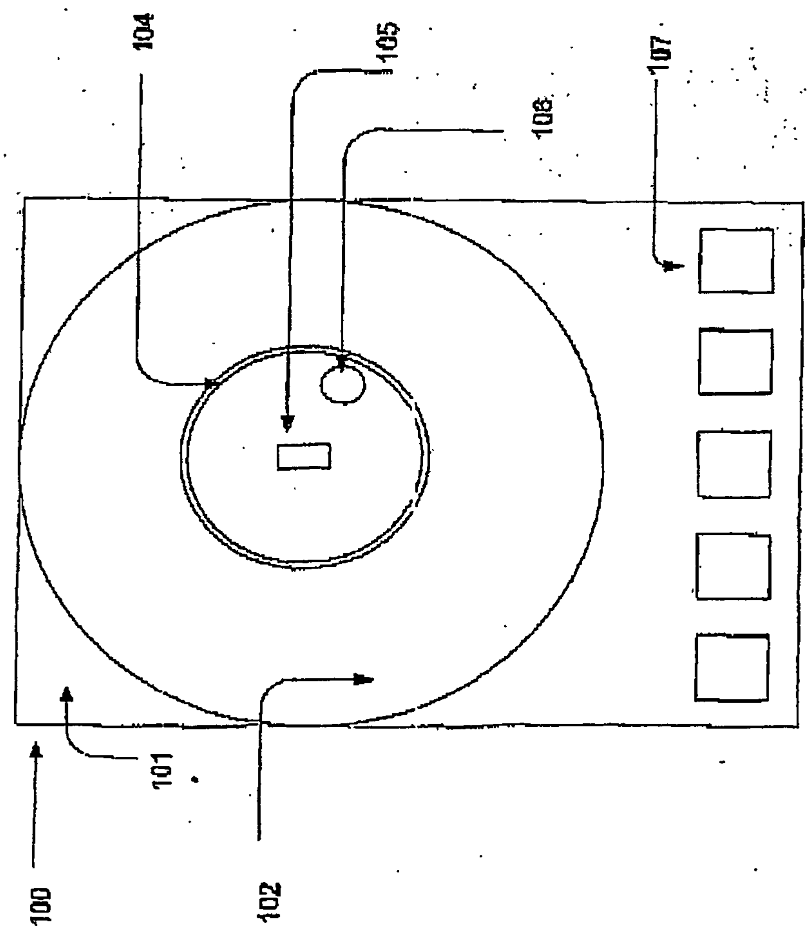

Figure 1

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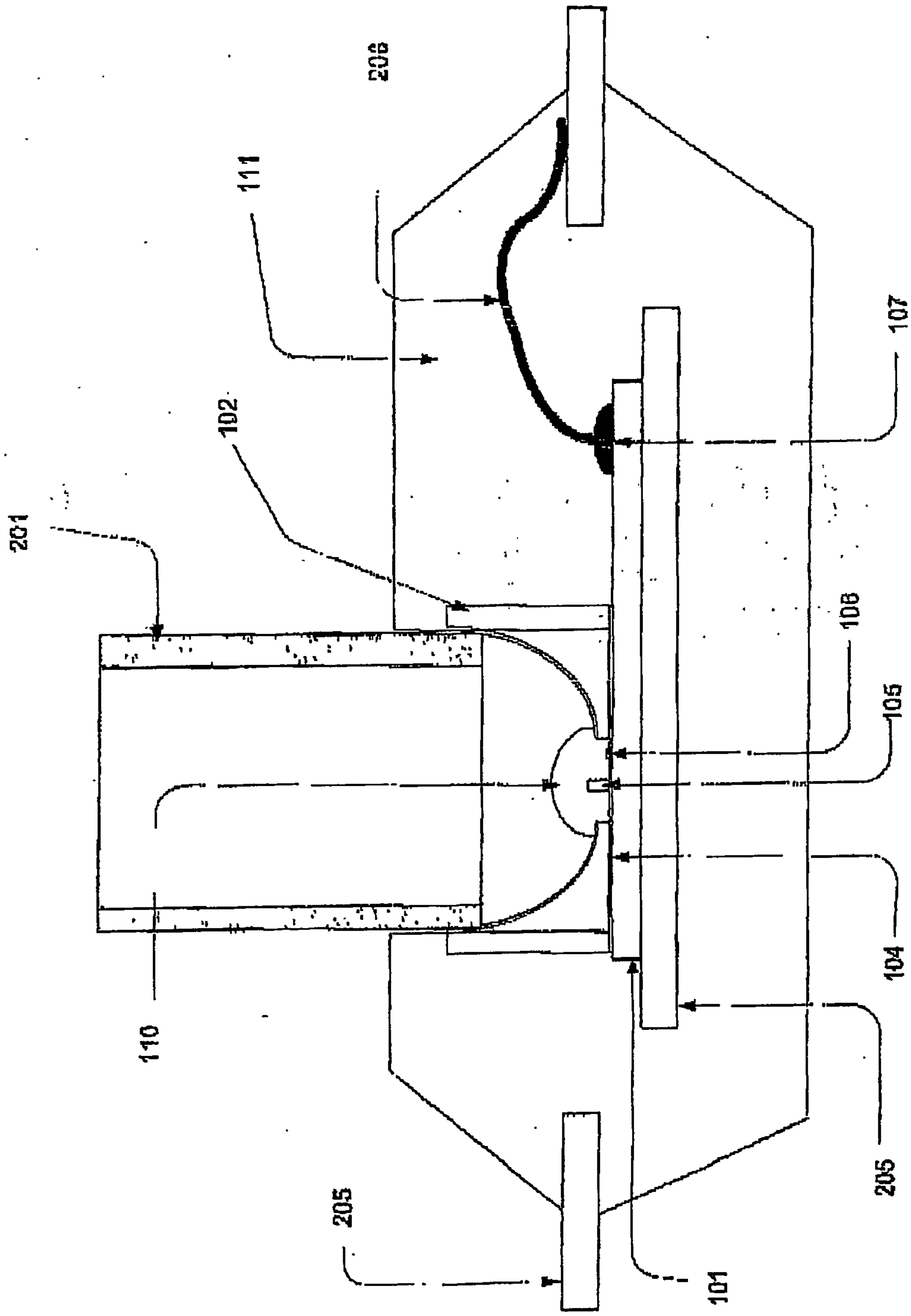

FIGURE 2